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(54) Abstract Title
A tolerance part for a collapsible steering wheel

(57) A collapsible steering column for a vehicle comprising a first elongate part 1, insertable into a second elongate part 2, with a tolerance part 3 locatable between the first and second parts, to take up the tolerance between them, and to provide a resistance force to telescopic collapse, between the first and second parts. The third part has at least two leaves 4, connected by an intermediate portion (4A, Fig 1A), which is arranged to seat on an end of the first part, when inserted in said second part. Both first and second parts may have a triangular cross-section, while the first part may be an inner tube of the column, with the second part forming an outer tube. The tolerance part may have three leaves, each of which, in use, lies against a respective face of the inner tube. Each of the leaves may have an outwardly extending tab 5 formed at the end, to provide an increased resistance load to telescopic collapse, and indentations or protrusions (6A, 6B and 6C, Fig 4, 5, and 6) on their surface to increase the frictional load between the inner and outer tubes.

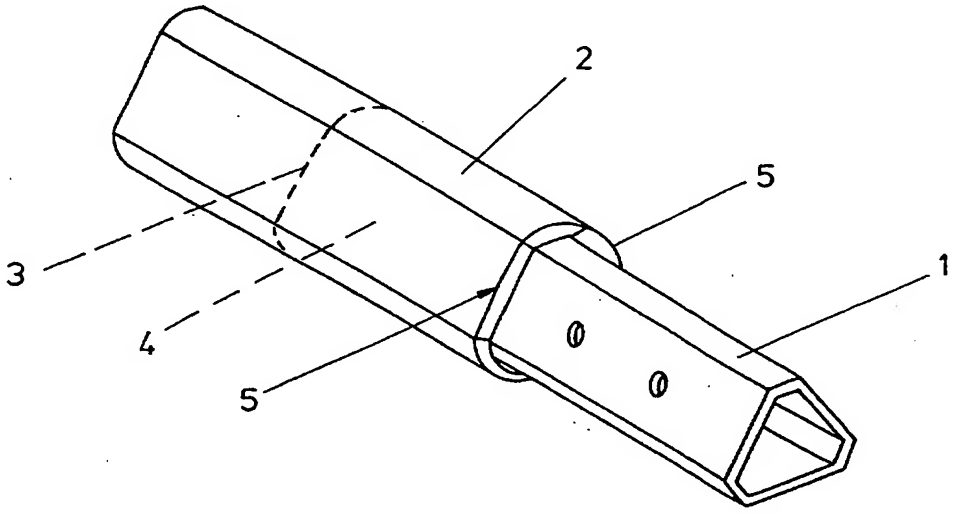

FIG. 1

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

The claims were filed later than the filing date but within the period prescribed by Rule 25(1) of the Patents Rules 1995.

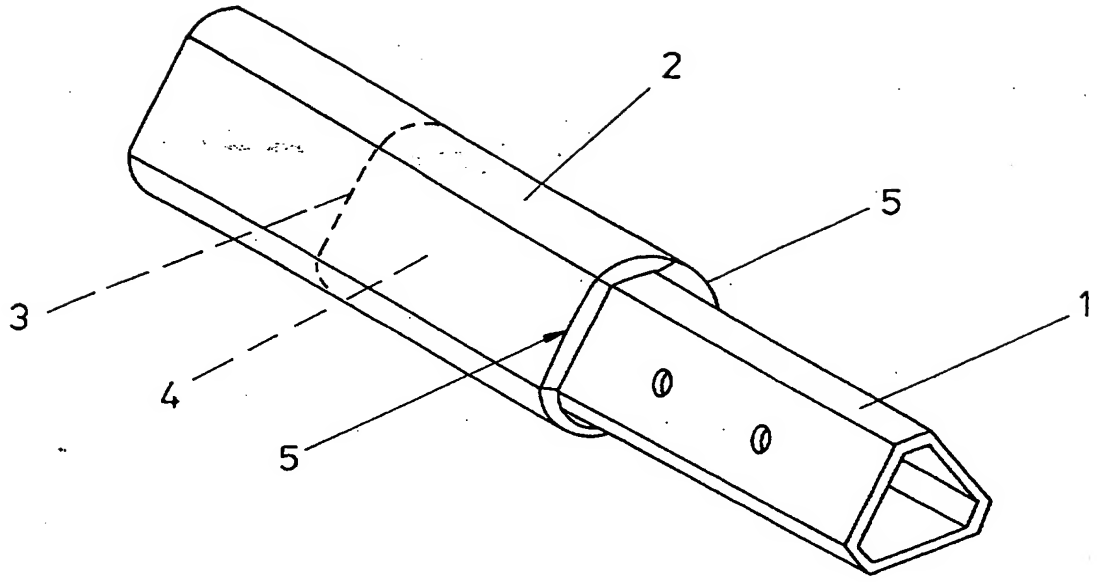

FIG. 1

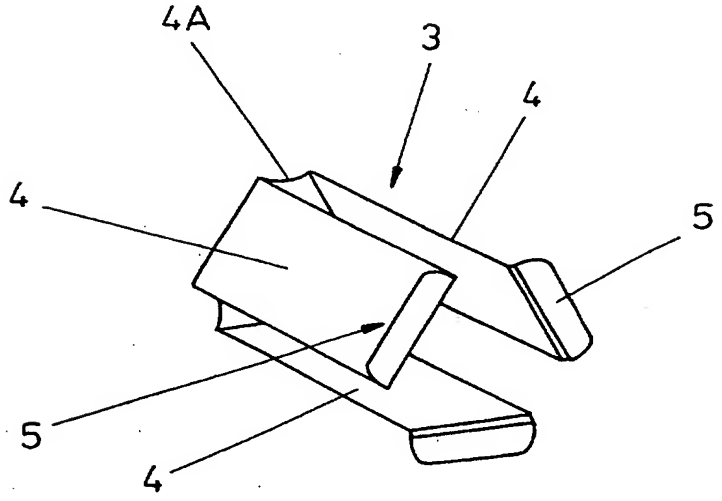

FIG. 1A

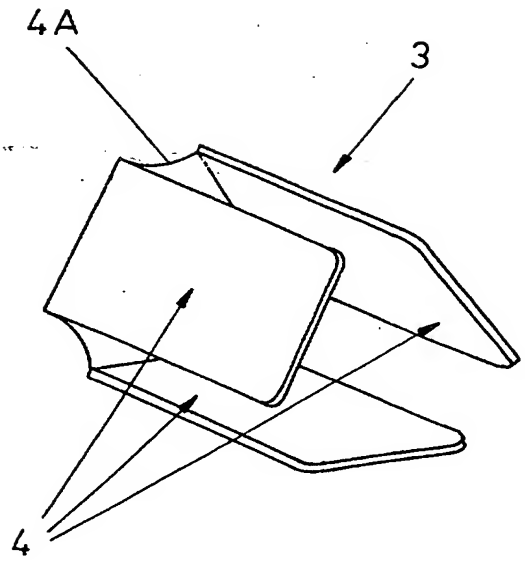

FIG. 2

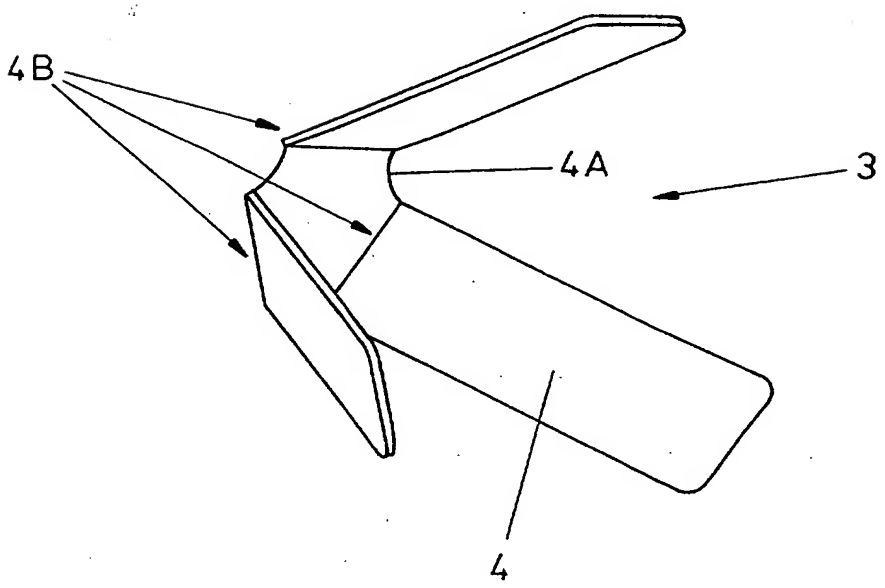

FIG. 3

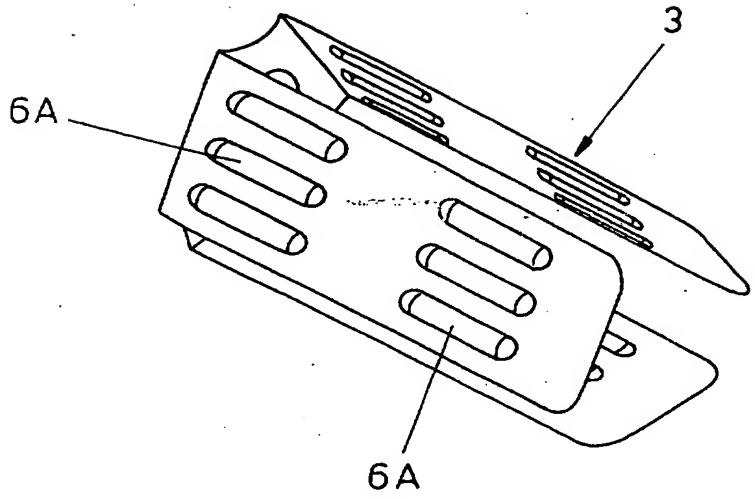

FIG. 4

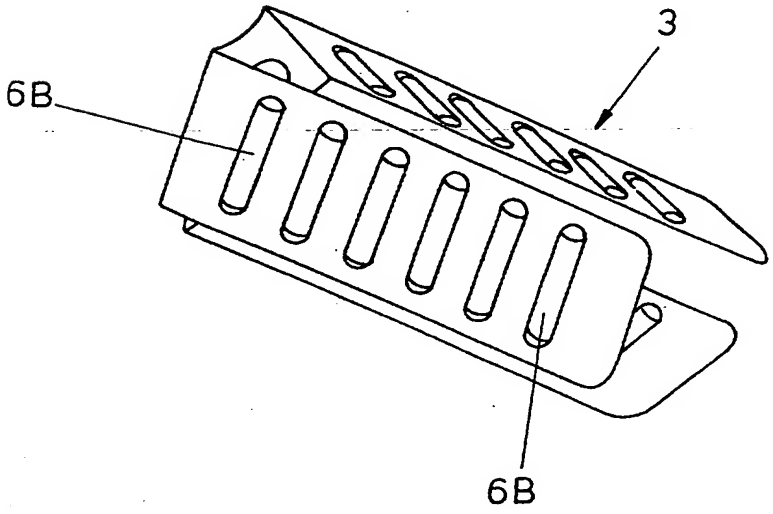

FIG. 5

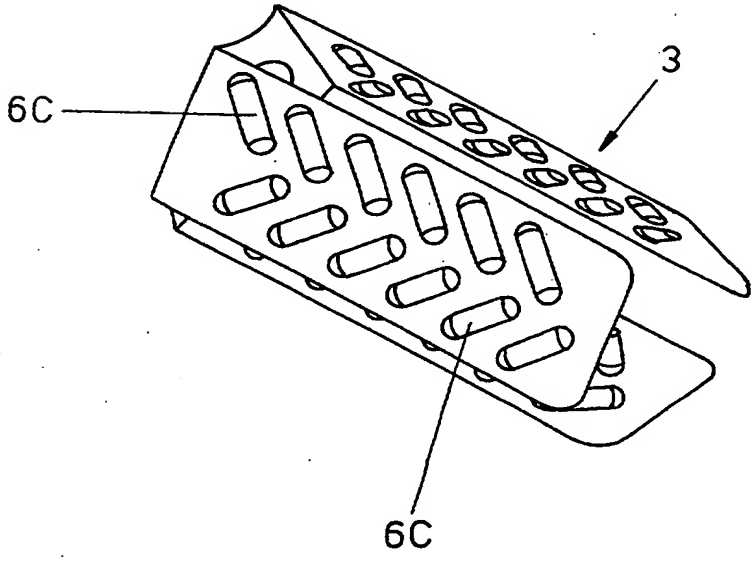

FIG. 6

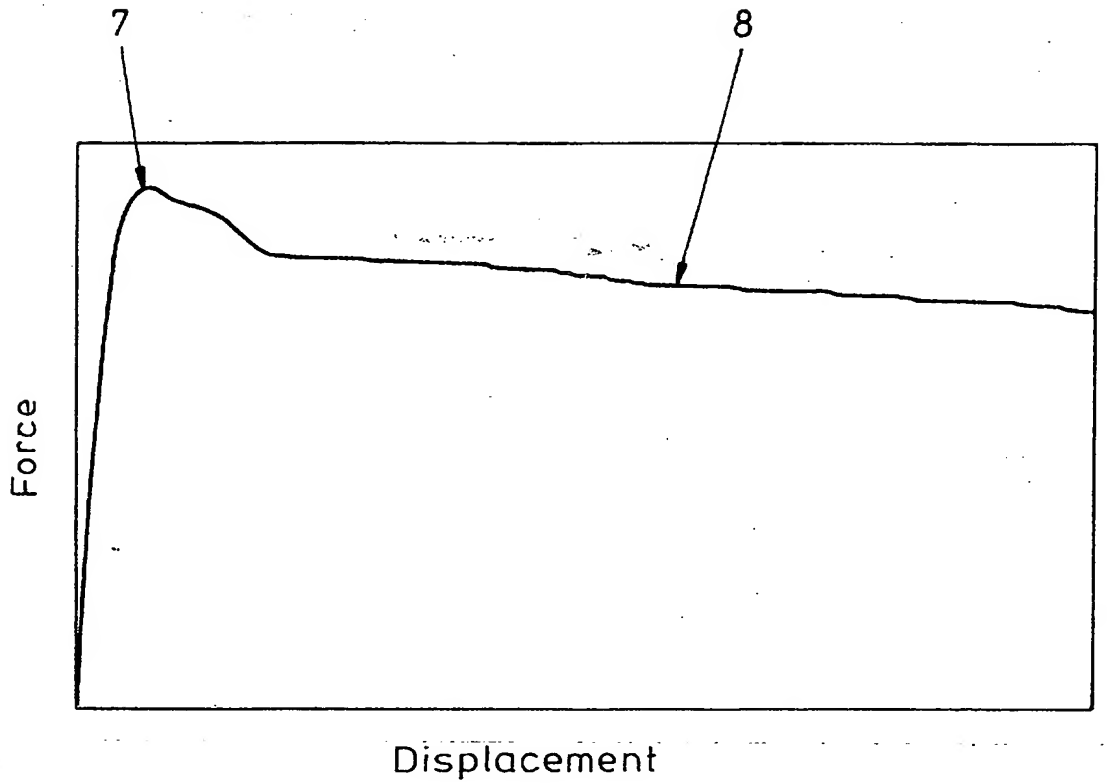

FIG. 7

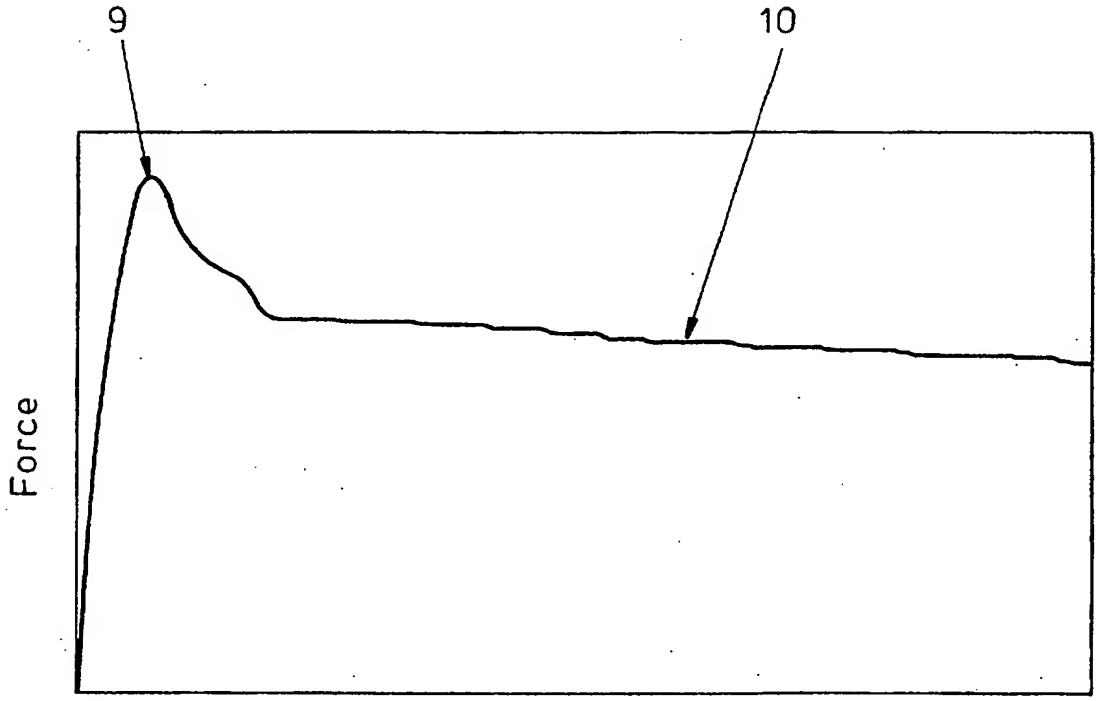

FIG. 8

A COLLAPSIBLE STEERING COLUMN FOR A VEHICLE AND A TOLERANCE PART THEREFOR

This invention relates to a collapsible steering column for a vehicle and to a tolerance part therefor.

According to one aspect of the present invention, there is provided a collapsible steering column for a vehicle, the steering column having a first elongate part insertable in a second elongate part, there being a third part locatable between the said first and second parts to take up tolerance therebetween and to provide a resistance force to telescopic collapse between said first and second parts, said third part having at least two leaves connected by an intermediate portion arranged to seat on an end of said first part that is to be inserted in said second part.

According to another aspect of the present invention, there is provided a tolerance part of a collapsible steering column for a vehicle, said tolerance part being locatable between a first elongate part and a second elongate part, said first elongate part being insertable in said second part and said tolerance part being for taking up tolerance between said first and second parts and to provide a resistance force to telescopic collapse between said first and second parts, said tolerance part having at least two leaves connected by an intermediate portion arranged to seat on an end of the first part that is to be inserted in said second part.

Said first part can be an inner tube of the steering column.

Said second part can be an outer tube of the steering column.

The inner surface of the outer tube and the outer surface of the first part can be given non-circular profiles to prevent relative rotation therebetween. The non-circular profile can be substantially triangular.

The intermediate portion of the third tolerance part can be profiled generally to match that of the cross-section of the end of the first part, with the two leaves extending along respective faces of the non-circular profile of the first part. In the case where the profile of the first part is substantially triangular, the third, tolerance part can have three leaves connected through the intermediate portion, each leaf being arranged, in use, to lie against a respective outer face of the first part.

Prior to seating the third, tolerance part on the end of the first part, the leaves can be splayed outwardly from the intermediate portion so that, upon location of the first part in the second part, the leaves are forced to bend at their connections with the intermediate portion to reach the installed condition inside the second part.

A free end of at least one leaf can be provided with a tab, extending outwardly from the first part when the third part is seated on it, the or each tab acting initially as a stop to restrict entry of the first part in the second part and subsequently, upon collapse of the steering column, will provide increased load through straightening of the or each tab as the first part is forced further into the second part.

At least one of the leaves can be provided with indentations and/or protrusions to increase the frictional load between the first and second parts when assembled with the third, tolerance part. The indentations/protrusions may be orientated axially of the leaves, transversely of the leaves and/or angled with respect to those axes.

The invention also extends to a vehicle including a collapsible steering column in accordance with the first aspect of the invention.

For a better understanding of the invention and to show how the same may be carried into effect, reference will now be made, by way of example, to the accompanying drawings, in which:-

Figure 1 is a diagrammatic, perspective view of a collapsible steering column for a vehicle incorporating a tolerance plate or part,

Figure 1A is a perspective view of the tolerance plate or part incorporated in the steering column of Figure 1,

Figure 2 is a diagrammatic perspective view of an alternative form of tolerance part, illustrated in the condition reached after insertion in the second part,

Figure 3 is a diagrammatic perspective view of the tolerance part of Figure 2 in its delivery condition prior to insertion in the second part,

Figures 4, 5 and 6 are perspective views illustrating further possible modifications to the tolerance part,

Figure 7 is a graph illustrating typical collapse load of the steering column provided by a tolerance part without tabs (Figures 2-6), and

Figure 8 is a graph similar to that of Figure 7 but showing a typical load when a tolerance part using tabs such as those illustrated in Figures 1 and 1A are used.

Figure 1 shows part of a steering column assembly including a first part in the form of a substantially triangular inner tube 1 which is inserted in an outer tube 2 which has a correspondingly substantially triangular inner profile. A third part, in the form of a so-called tolerance plate 3 is inserted in the tube 2 outside the tube 1 and is designed to take up tolerance between the two tubes and to provide a resistance force to telescopic collapse between the two tubes, thereby to eliminate clearance and pre-load the connection between the two tubes.

The tolerance plate 1 is better shown in Figure 1A and includes three leaves 4 connected by an intermediate base portion 4A which is arranged to seat on the inner end of the inner tube 1 that is to be inserted in the outer tube 2.

The free ends of each leaf 4 are, in the form shown in Figures 1 and 1A, each provided with an outwardly-extending tab 5. These optional tabs 5 on the tolerance plate 3 act to abut against the end of the outer tube 2 when the plate 3 is seated on the end of the inner tube 1 and the combination is inserted in the outer tube 2. The tabs 5 provide a visual aid to check if the inner tube has been assembled to the correct length in the outer tube and whether the collapse mechanism provided by the described structure has been accidentally/prematurely activated.

Figure 2 shows the form of tolerance plate 3 without tabs 5.

Figure 3 shows the tolerance plate 3 in its delivery condition with the faces 4 pre-bent to 60° as shown at 4B so that, in the delivery condition, a set of tolerance plates can be easily stacked during transportation/storage. In addition the tolerance plate 3 will self-locate on to the

end of the inner tube 1 for assembly and the initial insertion force to assemble the joint will be reduced, as the bends 4B act as stress raisers which will encourage the faces 4 to bend further to the installed condition.

Accordingly, upon assembly, the tolerance plate 3, when located over the end of the inner tube 1, utilises the inner tube 1 as a form of press tool when forced into the bore of the outer tube 2. The collapse load of the finished assembly can be completely checked by recording the force to assemble the joint.

Figures 4, 5 and 6 illustrate that at least one face 4 and, in the forms illustrated, all of the faces of the tolerance plate 3 can be provided with concave and/or convex indentations of various sizes, shapes and positions, so as to fine-tune the pre-load force and therefore to control the collapse load variation.

Figure 4 shows sets of convex protrusions 6A extending axially of the tolerance plate 3 (and inner tube 1), whilst Figure 5 shows transverse convex protrusions 6B and Figure 6 shows angled convex protrusions 6C (the degrees of angle can be varied).

As shown, the indentions are convex; however, the direction of the indentations can be concave and, indeed, a combination of both convex and concave formations 6 can be used.

Any combination of features as described above can be combined.

It will therefore be appreciated that, in the event of vehicle crash, there will be a tendency for the two tubes 1,2 to be telescoped together and the tolerance plate 3 will provide the load to absorb energy. When the tabs 5

are provided, there will be an increase in load required to unbend the tabs upon initial collapse.

Figure 7 shows the load upon such collapse in the case where the tabs 5 are not provided and it will be seen that an initial peak load 7 to generate collapse is not so pronounced, whilst the level of force 8 required to continue the collapse remains fairly constant.

Figure 8 illustrates the case where the tabs 5 are provided and here the initial peak load 9 to generate collapse is far more significant. The level of force 10 required to continue the collapse remains again fairly constant. The initial loading 9 simulates a break-away peak load.

It will be appreciated that the present construction provides two tubes of similar profiles inserted within each other with a tolerance plate which serves to eliminate all radial clearance by pre-loading the respective inner and outer faces of the tubes against each other. This pre-loading will provide the required axial break-away force to collapse the tube-in-tube construction of the steering column assembly.

The tolerance plate 3 can be made of any suitable material, e.g. of spring steel, stamped metal or of a plastics material.

CLAIMS

1. A collapsible steering column for a vehicle, the steering column having a first elongate part insertable in a second elongate part, there being a third part locatable between the said first and second parts to take up tolerance therebetween and to provide a resistance force to telescopic collapse between said first and second parts, said third part having at least two leaves connected by an intermediate portion arranged to seat on an end of said first part that is to be inserted in said second part.

2. A tolerance part of a collapsible steering column for a vehicle, said tolerance part being locatable between a first elongate part and a second elongate part, said first elongate part being insertable in said second part and said tolerance part being for taking up tolerance between said first and second parts and to provide a resistance force to telescopic collapse between said first and second parts, said tolerance part having at least two leaves connected by an intermediate portion arranged to seat on an end of the first part that is to be inserted in said second part.

3. A steering column or tolerance part according to claim 1 or 2, respectively, wherein said first part is an inner tube of the steering column.

4. A steering column or tolerance part according to claim 1 or 2, respectively, or claim 3, wherein said second part is an outer tube of the steering column.

5. A steering column or tolerance part according to claim 4, wherein the inner surface of the outer tube and the outer surface of the first part are given non-circular profiles to prevent relative rotation therebetween.

6. A steering column or tolerance part according to claim 5, wherein the non-circular profile is substantially triangular.

7. A steering column or tolerance part according to claim 5 or 6, wherein the intermediate portion of the third tolerance part is profiled generally to match that of the cross-section of the end of the first part, with the two leaves extending along respective faces of the non-circular profile of the first part.

8. A steering column or tolerance part according to claims 6 and 7, wherein the tolerance part has three leaves connected through the intermediate portion, each leaf being arranged, in use, to lie against a respective outer face of the first part.

9. A steering column or tolerance part according to claim 1 or 2, respectively, or to any one of claims 3 to 8, wherein, prior to seating said third or tolerance part on the end of the first part, the leaves are splayed outwardly from the intermediate portion so that, upon location of the first part on the second part, the leaves are forced to bend at their connections with the intermediate portion to reach the installed condition inside the said part.

10. A steering column or tolerance part according to claim 1 or 2, respectively, or to any one of claims 3 to 9, wherein a free end of at least one said leaf is provided with a tab, extending outwardly from said first part when said third or tolerance part is seated on it, the or each tab acting initially as a stop to restrict entry of said first part in said second part and subsequently, upon collapse of the steering column, to provide increased load through straightening of the or each tab as said first part is forced further into said second part.

11. A steering column or tolerance part according to claim 1 or 2, respectively, or to any one of claims 3 to 10, wherein at least one of said leaves is provided with indentations and/or protrusions to increase the frictional load between said first and second parts when assembled with said third or tolerance part therebetween.

12. A steering column or tolerance part according to claim 11, wherein the indentations and/or protrusions are orientated axially of the leaves, transversely of the leaves and/or angled with respect to those transverse and axial axes.

13. A collapsible steering column for a vehicle, substantially as hereinbefore described with reference to any one of the embodiments of the accompanying drawings.

14. A tolerance part of a collapsible steering column for a vehicle, substantially as hereinbefore described with reference to any one of the embodiments of the accompanying drawings.

15. A vehicle including a collapsible steering column in accordance with any one of claims 1 to 13.